

Introduction

Chapter Background

A strong national consensus supports the public funding of academic research, and although the Federal Government plays a diminishing role, it still provides close to 60 percent of the financial resources. More than half of academic research and development (R&D) funds go to the life sciences, and this share increased during the past quarter century, raising concern about whether the distribution of funds is appropriately balanced. The number of academic institutions receiving Federal support for R&D activities increased dramatically during the past several decades, expanding the base of the academic R&D enterprise. Recently, however, this number began to decline. The Federal Government plays a minor role in providing direct support to universities and colleges for construction of their research facilities. Nevertheless, the amount of academic science and engineering (S&E) research space grew continuously over the past decade. In contrast, the Federal Government accounted for almost 60 percent of direct expenditures of current funds for academic research equipment, but the percentage of total annual R&D expenditures devoted to such equipment declined noticeably during the past decade. Doctoral S&E faculty in universities and colleges play a critical role in ensuring an adequate, diverse, and well-trained supply of S&E personnel for all sectors of the economy. Until recently, positive outcomes and impacts of R&D were taken for granted; however, the system has begun to face demands that it devise means and measures to account for specific Federal R&D investments.

This chapter addresses key issues of the academic R&D enterprise, such as the importance of a Federal role in supporting academic research; the appropriate balance of funding across S&E disciplines; the breadth and strength of the academic base of the nation's S&E and R&D enterprise; the adequacy of research facilities and instrumentation at universities and colleges; the role of doctoral S&E faculty, including both their teaching and their research responsibilities; and accountability requirements, including measuring outputs and larger social outcomes.

Chapter Organization

The first section of this chapter discusses trends in the financial resources provided for academic R&D, including allocations across both academic institutions and S&E fields. Because the Federal Government has been the primary source of support for academic R&D for more than half a century, the importance of selected agencies in supporting individual fields is explored in detail. This section also presents data on changes in the number of academic institutions that receive Federal R&D support and then examines the status of two key elements of university research activities: facilities and instrumentation.

The next section discusses trends in the employment of academic doctoral scientists and engineers and examines their

activities and demographic characteristics. The discussion of employment trends focuses on full-time faculty, postdoctorates, graduate students, and other positions. Differences between the nation's largest research universities and other academic institutions are considered, as are shifts in the faculty age structure. The involvement of women and underrepresented minorities, including Asians/Pacific Islanders, is also examined. Attention is given to participation in research by academic doctoral scientists and engineers, the relative balance between teaching and research, and Federal support for research. Selected demographic characteristics of recent doctorate-holders entering academic employment are reviewed.

The chapter concludes with an assessment of two research outputs: scientific and technical articles in a set of journals covered by the Science Citation Index (SCI) and the Social Science Citation Index (SSCI) and patents issued to U.S. universities. (A third major output of academic R&D, educated and trained personnel, is discussed in the preceding section of this chapter and in chapter 2). This section looks specifically at the volume of research (article counts), collaboration in the conduct of research (joint authorship), use in subsequent scientific activity (citation patterns), and use beyond science (citations to the literature on patent applications). It concludes with a discussion of academic patenting and some returns to academic institutions from their patents and licenses.

Financial Resources for Academic R&D

Academic R&D is a significant part of the national R&D enterprise.¹ Enabling U.S. academic researchers to carry out world-class research requires adequate financial support as well as excellent research facilities and high-quality research equipment. Consequently, assessing how well the academic R&D sector is doing, the challenges it faces, and how it is responding to those challenges requires data and information on a number of important issues relating to the financing of academic R&D, including:

- ♦ the level and stability of overall funding,
- ♦ the sources of funding and changes in their relative importance,
- ♦ the distribution of funding among the different R&D activities (basic research, applied research, and development),
- ♦ the balance of funding among S&E fields and subfields (or fine fields),
- ♦ the distribution of funding among various types of academic R&D performers and the extent of their participation,

¹ Federally funded research and development centers (FFRDCs) associated with universities are tallied separately and are examined in greater detail in chapter 4. FFRDCs and other national laboratories (including Federal intramural laboratories) also play an important role in academic research and education, providing research opportunities for both students and faculty at academic institutions.